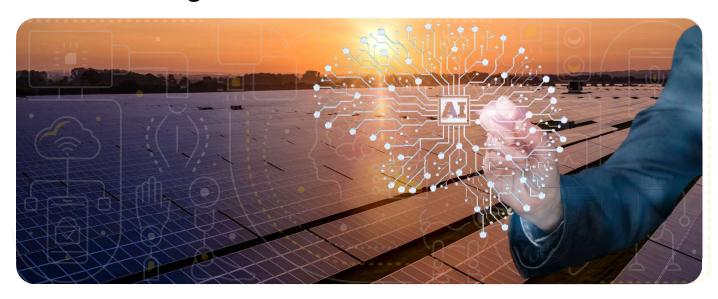# Accelerating the Future of Solar Energy in India Through Artificial Intelligence

SHANTANU ROY

Project Manager

Renewable Energy & Energy Efficiency Center for Study of Science, Technology and Policy (CSTEP)

As India fully embraces the renewable energy (RE) transition and works to achieve its energy targets, harnessing the potential of artificial intelligence (AI) can cause a transformative shift in the energy sector and pave the way for a smart energy future.

How AI can be a game changer

Solar energy generation in India encounters unique challenges owing to the diverse climate and geographical conditions across different regions, with some states receiving high solar irradiance and others facing harsh weather conditions. AI algorithms can help analyse local weather patterns and forecasts and provide solar irradiance data to optimise the design and operation of solar plants. Implementing AI-enhanced solar tracking systems can help maximise energy yields as well as operational efficiency and reliability, minimise downtimes, and provide better adaptability to geographic variations. This would be particularly useful for regions such as the Northeast having low solar irradiance and difficult climatic conditions.

Rooftop solar (RTS) is an integral component in realising India's ambitious RE targets. However, with India's current installed RTS capacity at only 12 GW, the RTS sector faces major challenges including low consumer awareness of RTS-related techno-economics and the absence of large-scale identification of suitable rooftops across India. AI solutions can help streamline the RTS adoption process by analysing satellite imagery, building patterns and height, building density, shadow-free areas, and energy consumption trends. Through such detailed analyses, AI solutions can provide accurate feasibility assessments and optimal RTS system designs. This can help consumers fully understand

their RTS potential and assist governments in identifying suitable rooftops for targeted awareness campaigns and demand aggregation. In view of the recent announcement of the Pradhan Mantri Suryodaya Yojana to solarise 1 crore households, AI solutions can be a powerful tool to empower households, businesses, and the government to accelerate the deployment of RTS installations throughout India.

Access to continuous and reliable power is often perceived as a barrier to socio-economic development in rural areas. Smart solar microgrids equipped with solar panels and energy storage can employ AI algorithms to manage energy flows, balance supply and demand, and prioritise critical loads. This can ensure uninterrupted and affordable electricity access for rural communities and remote villages while fostering economic growth.

AI-based energy storage systems can stabilise the power grid by managing and forecasting intermittent RE sources such as solar energy, ensuring reliability and seamless grid integration. AI-driven energy management systems can enable consumers to optimise energy usage, fostering energy efficiency, affordability, and sustainability. Further, AI-driven solar irrigation systems can optimise water and energy use for agriculture, enhancing productivity, conserving resources, and reducing emissions. Moreover, by providing valuable insights into energy consumption patterns, infrastructure requirements, and policy effectiveness, AI solutions can aid data-driven decision-making by policymakers.

Building a smarter and sustainable tomorrow

Leveraging the power of AI-based systems can help optimise solar energy production, empower rural communities, enhance grid stability, promote energy access, boost RTS adoption, and facilitate evidence-based policy formulation. As India continues to lead the global RE revolution, the use of AI in conjunction with solar energy can emerge as a catalyst for promoting innovation, efficiency, and inclusivity. With the right amalgamation of policies, R&D investments, and collaborations, India can utilise the power of AI to build a sustainable future for generations to come.